PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 29 June 2000 (29.06.00)	
International application No. PCT/IL99/00554	**Applicant's or agent's file reference** P-1800-PC
International filing date (day/month/year) 21 October 1999 (21.10.99)	**Priority date** (day/month/year) 22 October 1998 (22.10.98)
Applicant MERON, Gavriel et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

17 May 2000 (17.05.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Manu Berrod
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

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NOTIFICATION CONCERNING
AMENDMENTS OF THE CLAIMS

(PCT Rule 62 and
Administrative Instructions, Section 417)

To:

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in its capacity as International Preliminary Examining Authority

Date of mailing (day/month/year)	
29 June 2000 (29.06.00)	
International application No.	International filing date (day/month/year)
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Applicant

GIVEN IMAGING LTD. et al

The International Bureau hereby informs the International Preliminary Examining Authority that no amendments under Article 19 have been received by the International Bureau (Administrative Instructions, Section 417).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

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Manu Berrod

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PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

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NOTIFICATION OF DEFECTS IN DEMAND

(PCT Rule 60.1(d))

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Date of mailing (day/month/year) 29 June 2000 (29.06.00)	
International application No. PCT/IL99/00554	**International filing date** (day/month/year) 21 October 1999 (21.10.99)
Applicant GIVEN IMAGING LTD. et al	

The International Bureau hereby notifies the International Preliminary Examining Authority that it has found that the demand is defective for the reasons indicated below:

1. ☐ It does not contain the election of at least one Contracting State bound by Chapter II (Rule 53.2(a)(iv) and 53.7).
2. ☐ It does not permit the identification of the international application to which it relates (Rule 60.1(b)).
3. ☐ It does not contain the required petition (Rules 53.2(a)(i) and 53.3).
4. ☐ It does not contain the required indications concerning the agent as specified in the Annex (Rules 53.2(a)(ii) and 53.5).
5. ☐ It does not contain the required indications concerning the international application as specified in the Annex (Rules 53.2(a)(iii) and 53.6).
6. ☐ It is not submitted in the required language which is _____ (Rule 55.1).
7. ☐ It is not made on the printed form (Rule 53.1(a)).
8. ☐ It is presented as a computer print-out the particulars of which do not comply with the Administrative Instructions (Rule 53.1(a)).
9. ☐ It does not contain the required indications concerning the applicant as specified in the Annex (Rules 53.2(a)(ii) and 53.4).
10. ☒ It does not contain the required signature as specified in the Annex (Rules 53.2(b) and 53.8).

Other observations, if necessary:

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1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

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Telephone No.: (41-22) 338.83.38

NOTIFICATION OF DEFECTS IN DEMAND

International application No.
PCT/IL99/00554

Continuation of item 4: As to indi ıs concerning **the agent** (Rule 4.4), the demand:

a. ☐ does not properly indicate the agent's name (specify):

b. ☐ does not indicate the agent's address.

c. ☐ does not properly indicate the agent's address (specify):

Continuation of item 5: As to indications concerning **the international application**, the demand does not indicate:

a. ☐ the international filing date.

b. ☐ the international application number.

c. ☐ the name of the receiving Office, where the international application number was not known to the applicant at the time the demand was filed.

d. ☐ the title of the invention.

Continuation of item 9: As to indications concerning **the applicant** (Rules 4.4 and 4.5), the demand:

a. ☐ does not indicate all the applicants for the elected States.

b. ☐ does not properly indicate the applicant's name (specify):

c. ☐ does not indicate the applicant's address.

d. ☐ does not properly indicate the applicant's address (specify):

e. ☐ does not indicate the applicant's nationality.

f. ☐ does not indicate the applicant's residence.

Continuation of item 10: As to requirements concerning **signature** (Rules 4.15 and 90.4), the demand:

a. ☐ is not signed.

b. ☐ is not signed by all the applicants for the elected States.

c. ☐ is not accompanied by the statement referred to in the check list in Box No. VI of the demand explaining the lack of the signature of an applicant for the election of the United States of America.

d. ☒ is signed by what appears to be an agent/common representative but

☒ the demand is not accompanied by a power of attorney appointing him.

☐ the power of attorney accompanying the demand is not signed by all the applicants for the elected States.

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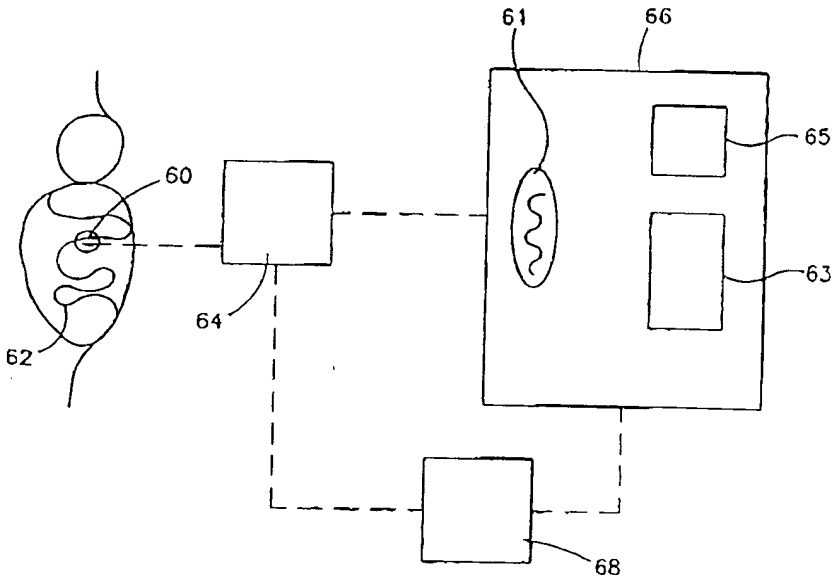

(57) Abstract

Capsule (60) moves through the gastrointestinal tract (62) in a first pass to generate a map of the gastrointestinal tract, and to identify a location of interest. In its second pass, capsule (60) moves through the gastrointestinal tract, and is controlled to perform a job at the identified location. Repeated localizations generate generate a map of the route taken by the capsule in the gastrointestinal tract (62). images displayed on the image monitor (61) are compared with the generated map displayed on the position monitor (63) to identify the location of a pathology (72).

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A METHOD FOR DELIVERING A DEVICE TO A TARGET LOCATION

FIELD OF THE INVENTION

The present invention relates to a method for identifying a target location in the gastrointestinal tract and for direct delivery of a device to the identified location.

BACKGROUND OF THE INVENTION

In the gastrointestinal tract, the stomach is connected, through the small intestine, a long tube that folds many times to fit inside the abdomen, to the large intestine. There are numerous pathologies of the gastrointestinal tract, such as lesions causing chronic gastrointestinal tract blood loss, which occurs in about 2% of US adults, malignancies, most of which give a poor prognosis, and bowel obstructions; simple, closed-loop, strangulated and incarcerated. Some of these pathologies, such as small intestinal tumors, are difficult to diagnose. Diagnostic methods of the small intestine are usually symptom related or invasive, such as barium enemas or surgery. New methods of diagnosis can lead to an earlier diagnosis and improved prognosis.

US patent number 5,604,531 describes an *in vivo* video camera system which can image the gastrointestinal tract. Reference is now made to Fig. 1, which is a block diagram illustration of a prior art *in vivo* video camera system for imaging the gastrointestinal tract. The *in vivo* video camera system typically comprises a swallowable capsule 10 for viewing inside the digestive system and for transmitting

video data, reception system 12 typically located outside a patient, and a data processor 14 for processing the video data. The data processor 14 typically operates two monitors, a position monitor 16 on which the current location of the capsule 10 within the digestive system is displayed and an image monitor 18 on which the image currently viewed by the capsule 10 is displayed.

The reception system 12 can either be portable, in which case, the data it receives is temporarily stored in a storage unit 19, prior to its processing in data processor 14, or it can be stationary and close to the data processor 14.

Reference is now made to Figs. 2 and 3 which are a schematic illustration of calculations performed by a prior art data processor for processing the video data obtained by the above *in vivo* video camera system. Fig. 2 is a front view illustration of the patient 22 with an antenna array 30 wrapped around him. On it, four antennas 34a - 34d are noted. Antennas 34a and 34b are located in a column at one side of the patient 22 and antennas 34c and 34d are located in a column at the other side of the patient 22.

Since the strength of a signal received by any given antenna depends on its distance from and angle to the transmitter, the ratio of the signal strengths between any two antennas, which have the transmitter between them, is constant along a curve which intersects the location of the transmitter. Thus, antennas 34a and 34b define curve 30a and antennas 34c and 34d define curve 30b.

The intersection of curves 30a and 30b is the location of the transmitter which is the location of the capsule 10. The curves 30a and 30b are typically determined in a calibration step for a pre defined number of constant values.

The designation of antennas 34a - 34d depends on and is determined from the width L_1 of the patient 22, which value is typically provided to data processor 14 (of Fig. 1). Alternatively, there can be a plurality of antenna arrays 30, one for each of a pre-defined number of widths L_1. The antennas 34a - 34d are then constant for each antenna array 30.

The location of the capsule 10, thus generated, is typically denoted by a two-dimensional vector **P**, having a length P and an angle □, from the center point O of an X-Y coordinate system.

The cross-sectional location (within an X-Z plane) of the capsule 10 can also be determined using a similar calculation to that illustrated in Fig. 2. A cross-section of the patient 22 is illustrated in Fig. 3. For this determination, four antennas 34e -34h, which are opposite in a cross-sectional manner, are utilized.

Once again, the ratio of the signal strengths between two antennas, which have the transmitter between them, is constant along a curve which intersects the location of the transmitter. Thus, antennas 34e and 34h define curve 30c and antennas 34f and 34g define curve 30d.

The location of the capsule 10 thus generated is typically denoted by a two-dimensional vector **Q** having a length Q and an angle □, from the center point O.

The two vectors **P** and **Q** are combined to determine the three-dimensional location of the capsule 10. The location can be displayed two- or three-dimensionally on position monitor 16 (of Fig. 1), typically, though not necessarily, as an overlay to a drawing of the digestive tract.

There exist methods for the delivery of medicament to a selected site in

the gastrointestinal tract, such as the use of time delivery capsules made of material that dissolves in a particular environment and/or within a particular time period, within the gastrointestinal tract. In these methods, the delivery of medicament is dependent on the predictability of the particular environment to which the capsule is directed.

Controllable apparatuses for delivery of medicaments are described in US patents 5,558,640 and 4,239,040. While using these apparatuses or capsules the delivery of medicament may be obstructed, such as by folds in the intestine.

These methods can not be relied upon for localized release of a medicament.

US patent 5,279,607 describes a method of obtaining directional data from the passage of an ingestible radio signal transmitting capsule. This data is subsequently compared to directional data from a capsule carrying medicament passing through the alimentary canal, for remotely triggering the release of medicament at a calculated geometric location along the gastrointestinal tract. A location selected in this method, cannot be aligned with sites of interest, such as pathologies, since no diagnostic information, such as information relating to the pathology, can be obtained in this method. Furthermore, due to the constant peristaltic movement of the alimentary canal, the geometric location of a site is not the same in a first and second pass, so that this one parameter is only partially sufficient for selection of a site.

There exist no medicament delivering systems which combine diagnostic and therapeutic processes.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method for delivering a utility device to a target location in the gastrointestinal tract. The method combines identification of a target in the gastrointestinal tract and delivery of a utility device to the identified target location. The method of the present invention comprises the steps of:

a) generating a map of the gastrointestinal tract, employing a sensing and utility device for a first pass, or, optionally, a plurality of passes through the gastrointestinal tract; and

b) delivering the sensing and utility device to a target location identified on the map, using the sensing and utility device in a second pass or, optionally, a plurality of passes, through the gastrointestinal tract. The sensing and utility device used in the second pass, may be the same or different than the device used in the first pass.

The term "sensing and utility device", in the present invention, refers to a device which is swallowable or placeable (such as described in IL patent application number 122716, assigned to the common assignees of the present invention and which is hereby incorporated by reference), and is capable of sensing selected parameters of the gastrointestinal tract. The device also comprises means for performing a job in the gastrointestinal tract. It is controllable and is capable of being monitored and of generating a map of the gastrointestinal tract.

The sensing and utility device may comprise, for example, any one or any combination of a video camera, which generates an image of the

gastrointe l tract, or sensing means, such as temperature, pressure or pH sensors or means for sensing the presence of blood, microorganisms, parasites or pathological indications or any objects alien to the gastrointestinal tract.

Means for performing a job may be any means suitable for researching, diagnosing or treating pathologies in the gastrointestinal tract, for example, fluid or cell sampling means, marker releasing means or medicament releasing means.

A map of the gastrointestinal tract may be generated by inserting the sensing and utility device into the gastrointestinal tract, monitoring the progress of the device through the gastrointestinal tract and optionally displaying the locations, two or three dimensionally, on a position monitor.

Monitoring the device is by periodically or repeatedly locating the device, preferably, as described in US patent number 5,604,531 assigned to the common assignees of the present invention. US 5,604,531 is hereby incorporated by reference.

Delivering the sensing and utility device to a target location identified on the map comprises the steps of inserting the sensing and utility device into the gastrointestinal tract, in a second pass, receiving data from the device, either visual, from a video camera, or from the output of other sensing means, performing signal analysis of the data generated in the first pass and the data received from said sensing and utility device in the second pass; and controlling, such as by IR or telephony, the sensing and utility device according to the signal analysis.

The method of the present invention may be used for research, diagnostic or therapeutic purposes in the gastrointestinal tract .

BRIEF DESCRIPTION OF THE FIGURES

The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the drawings in which:

Fig. 1 is a block diagram illustration of a prior art *in vivo* video camera system for imaging the gastrointestinal tract;

Figs. 2 and 3 are schematic illustrations of calculations performed by a prior art data processor for processing the video data obtained by the *in vivo* video camera system for imaging the gastrointestinal tract, utilizing an antenna array, wherein Fig. 3 is a top view illustration of the antenna array and Fig. 2 is a cross-sectional illustration of the antenna array.

Fig. 4 is an illustration of a sensing and utility device according to a preferred embodiment of the invention;

Fig. 5A is an illustration of a storage compartment, according to a preferred embodiment of the invention, in a recoiled position of the bi stable spring;

Fig. 5B is an illustration of a storage compartment, according to a preferred embodiment of the invention, in an extended position of the bi stable spring;

Fig. 5C is an enalrgement of the storgae compartment tip, according to a preferred embodiment of the invention;

Fig. 6 is an illustration of a sensing and utility device operable according to a preferred embodiment of the invention; and

Fig. 7 is an illustration of a generated and displayed map in the method according to a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The method of the present invention combines diagnostic and therapeutic processes. For example, the method combines identifying and localizing a pathology in the gastrointestinal tract with administrating treatment to the location of the pathology, by non invasive means. This combination is provided by employing a sensing and utility device which is inserted into the gastrointestinal tract, either by swallowing it or by placing it in the gastrointestinal tract. The above mentioned IL patent application 122716 describes a device for the placement of an autonomous capsule in the gastrointestinal tract, which bypasses the need for swallowing the capsule by the patient.

Reference is now made to Fig. 4 which is an illustration of a sensing and utility device according to a preferred embodiment of the invention. The sensing and utility capsule shaped device, generally referenced 40, typically comprises a light source 42, a viewing window 44, through which the light illuminates the inner portions of the digestive system, a camera system 46, such as a charge-coupled device (CCD) or CMOS camera, which detects the images, an optical system 48 (typically comprising a mirror 47 and a focusing lens 47') which focuses the images onto the CCD or CMOS camera system 46, a transmitter 41, which transmits the video signal of the CCD or CMOS camera system 46, a power source 43, such as a battery, which provides power to the entirety of electrical elements of the capsule and a storage compartment 45, for the controllable discharge of medicaments or markers or for the controllable collection of fluid or cell samples from the environment, such as in a biopsy procedure.

The sensing and utility device can additionally include any known sensor

element 45 such as temperature, pressure or pH sensors or means for sensing the presence of blood, microorganisms, parasites or pathological indications or any objects alien to the gastrointestinal tract.

Reference is now made to Figs. 5A, 5B and 5C which are illustrations of a storage compartment, according to a preferred embodiment of the invention.

Storage compartment 55 is located preferably at an end of the sensing and utility device, generally referenced 50. The storage compartment is defined by an inflexible barrier 59 and the device shell. The storage compartment contains a pouch 56 made of flexible material which is encased by the device outer shell 52 and by a firm diaphragm 54 having an elasticity which will allow it to accommodate to a capsule shape. Diaphragm 54 is horizontally movable between the inflexible barrier 59 and the device tip. At the device tip there is an area 58, in the outer shell of the device, which is permeable and which allows passage of substances from or into the pouch 56. Permeability may be conferred, for instance by the area 58 being porous or sieve like. The pouch 56 is designed to retain substances such as releasable medicaments or markers or such as fluid or cell samples from the gastrointestinal tract environment. The pouch 56 bulk is determined by a bi stable spring 53, preferably made of a memory shape metal such as TiNi. The spring 53 is attached, at one end to the solid barrier 59, and at its other end, to the diaphragm 54. The spring 53 may be made to extend (as shown in Fig. 5B) or recoil (as shown in Fig. 5A) by providing different temperatures, as known in the art (the means for providing different temperatures, such as conducting wires, are not shown). Thus, the pouch 56 bulk may be reversably increased or decreased.

Fig. 5A illustrates a piercing pin 57 which is attached to the pouch wall

and which protrudes into the pouch 56 inner space, in the direction of the opposing pouch wall 56'. For releasing a substance from pouch 56 into the gastroinestinal tract environment, spring 53 is made to extend, causing diaphragm 54 to move towards the device end, thrusting the peircing pin 57 into the opposing pouch wall 56', rupturing it. A substance contained in the pouch 56 will be released into a space 51 provided between the opposing pouch wall 56' and the outer shell permeable area 58. The released substance may then pass through the openings in the permeable area 58 into the gastrointestinal tract.

Fig 5B illustrates a pouch 56 meant for collecting a sample from the gastrointestinal tract. In this embodiment the bi stable spring 53 is lodged in opposing pouch wall 56'. The spring 53 is made to recoil, pulling with it diaphragm 54 and piercing pin 57, such that piercing pin 57 is dislodged from the opposing pouch wall 56', rupturing it and leaving an opening in the pouch, through which substances from the environment are drawn into the pouch 56. The opening in the pouch is sealed after the sample is drawn in from the environment, ensuring a fixed volume and sterility of the collected sample.

Pin 57 may be a hollow cylinder through which substances may pass to or from the gastrointestinal tract.

Fig. 5C is an enlargement of the device end, through which substances are drawn into, or released from, the pouch. As can be seen in this figure, space 51 is provided, ensuring that the pin 57, either before being dislodged from wall 56' for collecting substances, or when piercing wall 56' for release of substances, doesn't protrude further than the device shell 52 and injure the patient's insides.

Reference is now made to Figs. 6 and 7. Fig. 6 is an illustration of a sensing and utility device operable according to a preferred embodiment of the invention, and Fig. 7 is an illustration of a map of the gastrointestinal tract generated in the method, according to a preferred embodiment of the invention.

Capsule 60 moves through the gastrointestinal tract 62 in a first pass to generate, by visual means, a map of the gastrointestinal tract and to identify, by visual means or other sensor means, a location of interest in the gastrointestinal tract. In its second pass, capsule 60 moves through the gastrointestinal tract and is controlled to perform a job at the identified location.

Recognition of the location, identified in the first pass, is done , in analyzing unit 65, by analysis of the map generated in the first pass and bringing into conformity parameters, visual or others, obtained in the first pass and in the second pass. This may be acheived by any of the well known techniques of image matching by correlation, as done in image analysis, or any other suitable signal analysis techniques.

As the capsule 60 moves through the digestive system (gastrointestinal tract) 62, in its first pass, it views the walls of the digestive system in the method described in Figs. 2 and 3 and in US 5,604,531, and transmits the resultant images to a reception system 64 typically located outside a patient. The reception system 64 receives a multiplicity of versions of the images, each version received by a different antenna (described in Figs. 2 and 3) and either stores the received signals in the storage unit 68 or provides the received signals, directly, by IR or telephony, to the data processor 66. The data processor 66 typically operates two monitors, a position monitor 63, on which the current location of the capsule 60

within the digestive system is recorded, and, optionally, displayed and an image monitor 61, on which the image currently viewed by the capsule 60 is displayed.

The reception system 64 can either be portable, in which case, the data it receives is temporarily stored in a storage unit 68 prior to its processing in data processor 66, or it can be stationary and close to the data processor 66.

The capsule 60 location can be displayed two- or three-dimensionally on position monitor 63, typically, though not necessarily, as an overlay to a drawing of the digestive tract. The progress of capsule 60 is monitored by repeated or periodic localization of the capsule, and can be displayed on position monitor 63.

A forward filming device can be distinguished from a backwards filming device by the flow direction of the image. Information relating to the direction of the device motion enables more precise localization of the storage compartment end of the device. Furthermore, analysis of the optical flow enables to calculate the device velocity in the gastrointestinal tract.

The repeated localizations generate a map of the route taken by the capsule in the gastrointestinal tract 62. The generated map 70 is shown in Fig. 7. For maximum accuracy, images displayed on image monitor 61 are compared with the generated map 70 displayed on position monitor 63 to identify the location of a pathology 72, though, a location may be identified by analysis of parameters other than visual (such as pH, temp, etc.), which were sensed during the first pass in the gastrointestinal tract.

Upon identifying the location of a pathology 72 on the gastrointestinal tract map 70, either visually or by analysis of other sensor means input, capsule 60 is inserted into the gastrointestinal tract for a second pass. As capsule 60

moves thro the digestive system 62, in its second pass, it is monitored as above. When arriving at the location of the pathology 72, or at any other point on map 70, determined as the point for advantageously releasing medicament for the treatment of the pathology, the capsule 60 is controlled to release the medicament from the medicament storage compartment of the capsule (45 in Fig. 4). The release of the medicament may be autonomous, automatically controlled by analyzing unit 65 or remotely controlled by an external operator.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described herein above. Rather the scope of the invention is defined by the claims which follow:

CLAIMS

1. A method of delivering a sensing and utility device to a target location in the gastrointestinal tract comprising the steps of:

generating a map of the gastrointestinal tract employing a sensing and utility device for a first pass through the gastrointestinal tract; and

delivering said sensing and utility device to a target location identified on said map using said sensing and delivering device in a second pass.

2. The method according to claim 1 wherein the sensing and delivering device is a capsule comprising;

sensing means for generating data in a first and second pass through the gastrointestinal tract;

means for signal analysis of the data generated in the first and second pass;

means for controlling the sensing and utility device according to said signal analysis; and

means for performing a job in the gastrointestinal tract.

3. The method according to claim 1 wherein the step of generating a map of the gastrointestinal tract comprises the steps of :

inserting the sensing and utility device into the gastrointestinal tract;

locating said sensing and utility device; and

displaying the location on a position monitor.

4. The method according to claim 3 further comprising a step of displaying the location of the device two or three dimensionally.

5. The method according to claim 4 wherein the location of the device is displayed as an overlay to a schematic presentation of the gastrointestinal tract.

6. The method according to claim 1 wherein the step of delivering the sensing and utility device to a target location identified on the map generated in the first pass, comprises the steps of :

inserting the sensing and utility device into the gastrointestinal tract, in a second pass;

receiving data from said sensing and utility device;

performing signal analysis of the data generated in the first pass and of the data generated in the second pass; and

controlling said sensing and utility device according to said signal analysis.

7. The method according to claim 1 wherein the first pass and second pass are one or more passes.

8. The method according to claim 1 wherein the target location is a location of a pathology.

9. A sensing and utility device for performing a job at a target location in a gastrointestinal tract comprising:

sensing means for generating data in a first and second pass through the gastrointestinal tract;

means for signal analysis of the data generated in the first and second pass;

means for performing a job in the gastrointestinal tract; and

means for controlling the sensing and utility device and the means for performing a job, operable according to said signal analysis.

10. The device according to claim 9 wherein the sensing means sense parameters of the gastrointestinal tract in a first and second pass and wherein the means for signal analysis analyze the sensed parameters.

11. The device according to claim 10 wherein the means for controlling the sensing and utility device are operable according to the analysis of the sensed parameters in the first and second pass.

12. The device according to claim 9 wherein the means for performing a job in the gastrointestinal tract are selected from means for releasing substances into the gastrointestinal tract and means for collecting substances from the gastrointestinal tract.

13. A system for delivering a sensing and utility device to a target location in the gastrointestinal tract comprising:

a sensing and utility device consisting of:

a camera system;

an optical system for sensing an area of interest onto said camera system;

a transmitter which transmits video output of said camera system; and

means for performing a job in the gastrointestinal tract;

a reception system which receives said transmitted video output, said reception system comprising;

an antenna array capable of surrounding a body and comprising a plurality of antennas for receiving said transmitted video output and for producing a plurality of received signals;

a demodulator capable of transforming said plurality of received video signals into a single video data stream; and

a data processing system which generates tracking and video data from said single data stream;

and

an analyzing unit for signal analysis of said video output and for controlling the sensing and utility device.

14. The system according to claim 13 wherein the sensing and utility device is swallowable.

15. The system according to claim 13 wherein the sensing and utility device is placeable in the gastrointestinal tract.

16. A storage compartment, enclosed in a sensing and utility device, for releasing and collecting substances to and from the gastrointestinal tract, having an inflexible barrier as a first wall, and said device shell as a second wall, said second wall opposing said first wall, and comprising:

a flexible pouch for retaining said substances, said pouch encased within said inflexible barrier and device shell;

a bi stable spring attached to the inflexible barrier, at one end, and to the flexible pouch at another end, for controlling the pouch bulk; and

means for changing the bi stable spring configuration, for extending the spring to decrease pouch bulk and for recoiling the spring to increase pouch bulk.

17. The storage compartment according to claim 16 further comprising a firm diaphragm, having elasticity which enables it to accommodate to a device shape, and which is horizontally movable between the inflexible barrier and device shell, said diaphragm situated at the attachment site of the bi stable spring and the flexible pouch, and attached to both flexible pouch and bi stable spring, for pushing or pulling the flexible pouch relatively to the compartment walls.

18. The storage compartment according to claim 17 further comprising means for rupturing the flexible pouch for releasing a substance from said pouch to a patient's gastrointestinal tract and for collecting into said pouch substances from a patient's gastrointestinal tract.

19. The storage compartment according to claim 18 wherein the device shell contains an area which is permeable to the released and collected substance.

20. The storage compartment according to claim 19 wherein the means for rupturing the flexible pouch is a pin, said pin being attached to a first pouch wall while protruding in the direction of a second pouch wall, said second pouch wall being opposed to said first pouch wall,

and wherein the pin is thrust into the second pouch wall to rupture it for releasing a substance from the pouch.

21. The storage compartment according to claim 19 wherein the means for rupturing the flexible pouch is a pin, said pin being attached to a first pouch wall while being lodged in a second pouch wall, said second pouch wall being opposed to first pouch wall,

and wherein, for collecting a substance into the pouch, the pin is dislodged from the second pouch wall and moved in the direction of the first pouch wall, rupturing said second pouch wall.

22. The storage compartment according to claims 20 and 21 further comprising a space between the second pouch wall and the device shell for containing a pin tip protruding through the second pouch wall, for protecting a patient's gastrointestinal tract from the protruding pin tip.

23. Use of the method according to claim 1 for research, diagnostic or therapeutic purposes.

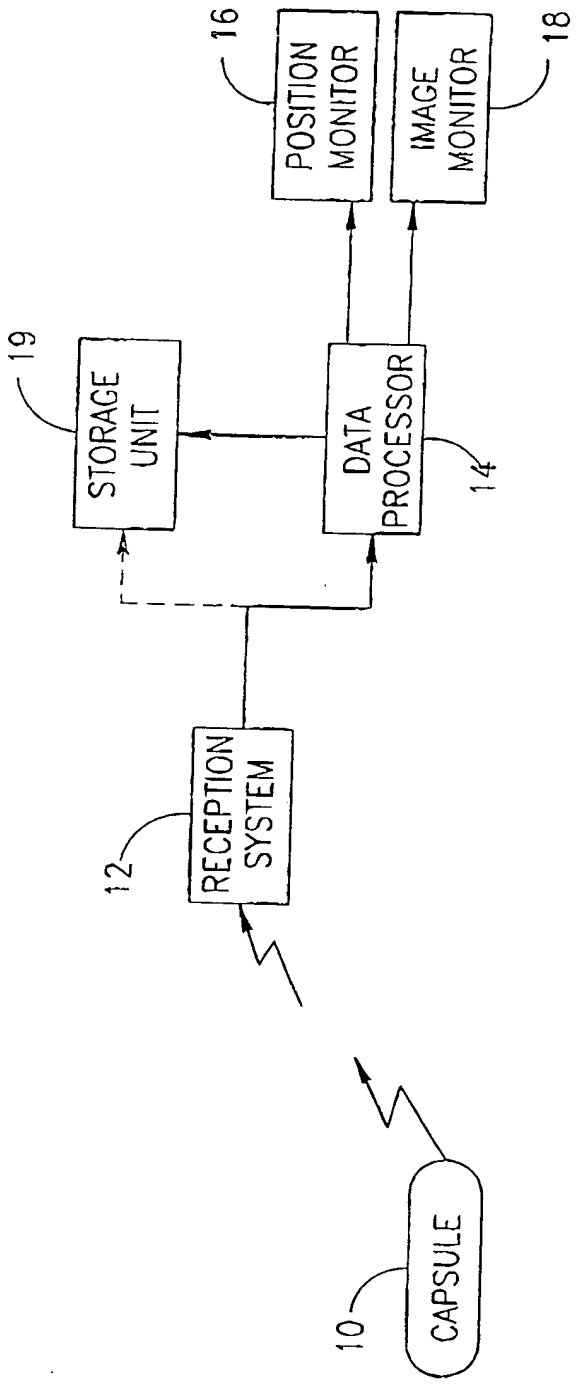

16
POSITION MONITOR
18
IMAGE MONITOR
19
STORAGE UNIT
DATA PROCESSOR
14
12
RECEPTION SYSTEM
10
CAPSULE

FIG.1

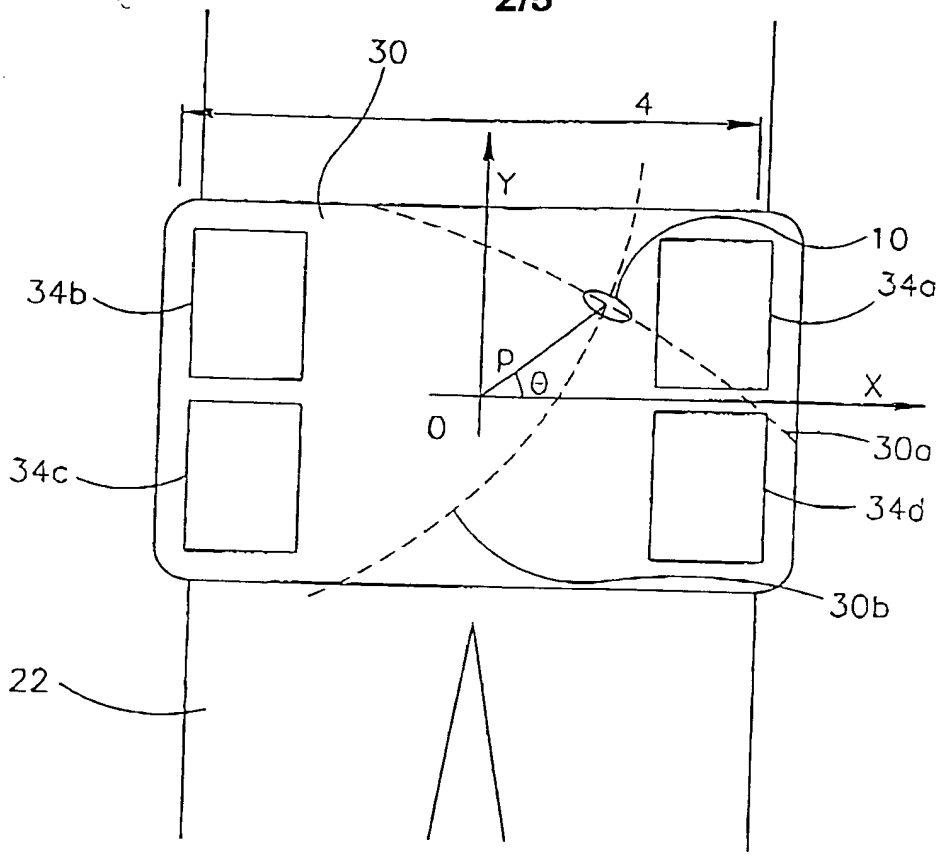
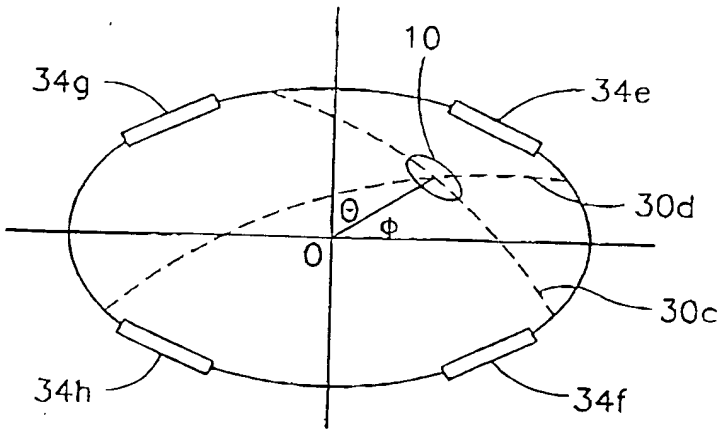

30
4
Y
10
34b
34a
P
θ
X
0
34c
30a
34d
30b
22

FIG.2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34g
34e
30d
θ
φ
0
30c
34h
34f

FIG.3

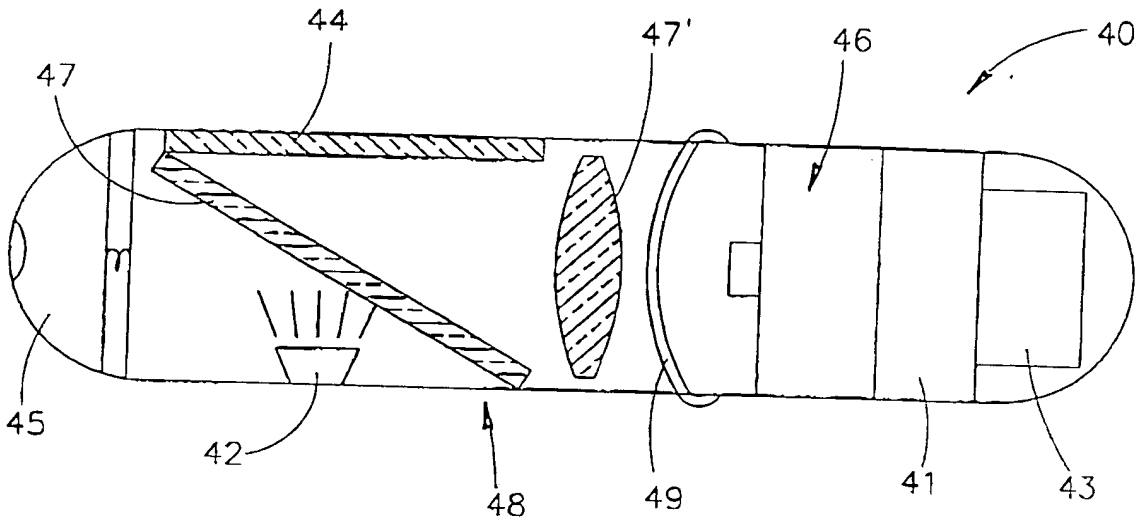

FIG.4

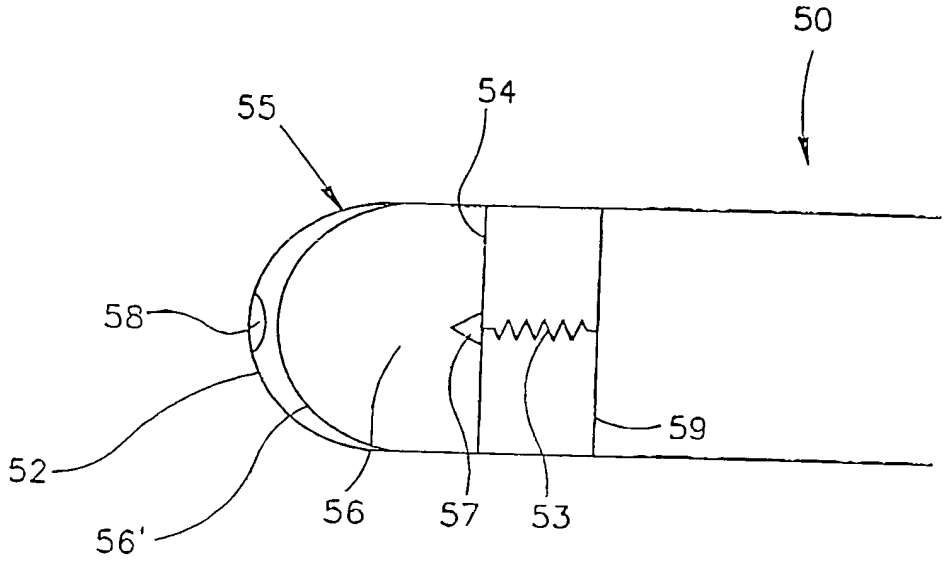

FIG.5A

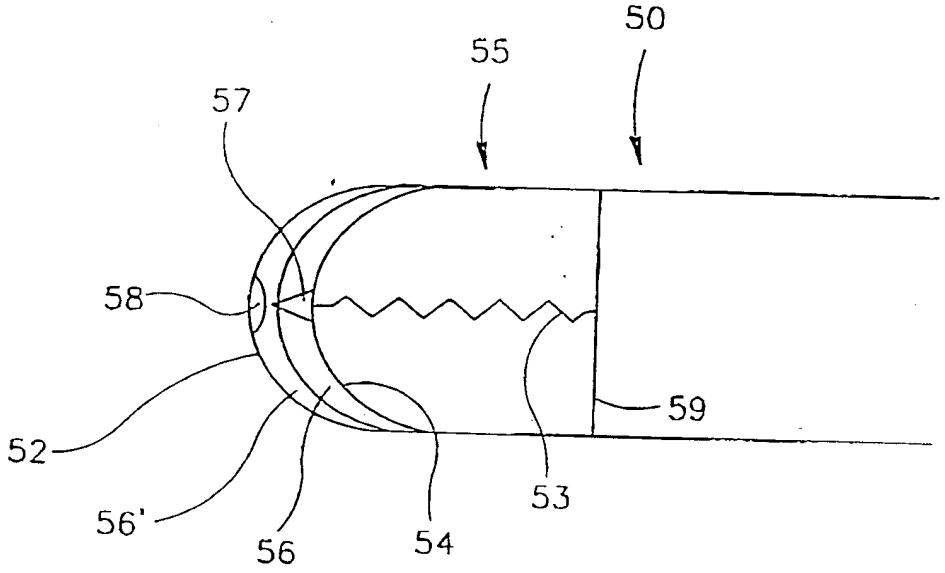

FIG.5B

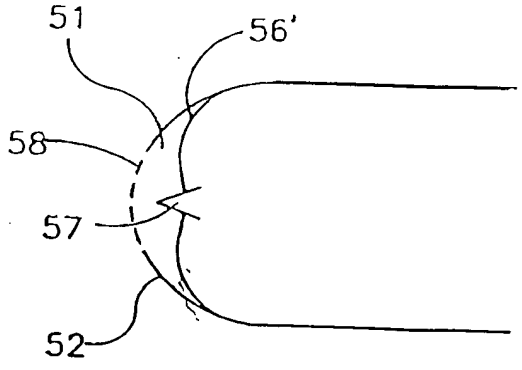

FIG.5C

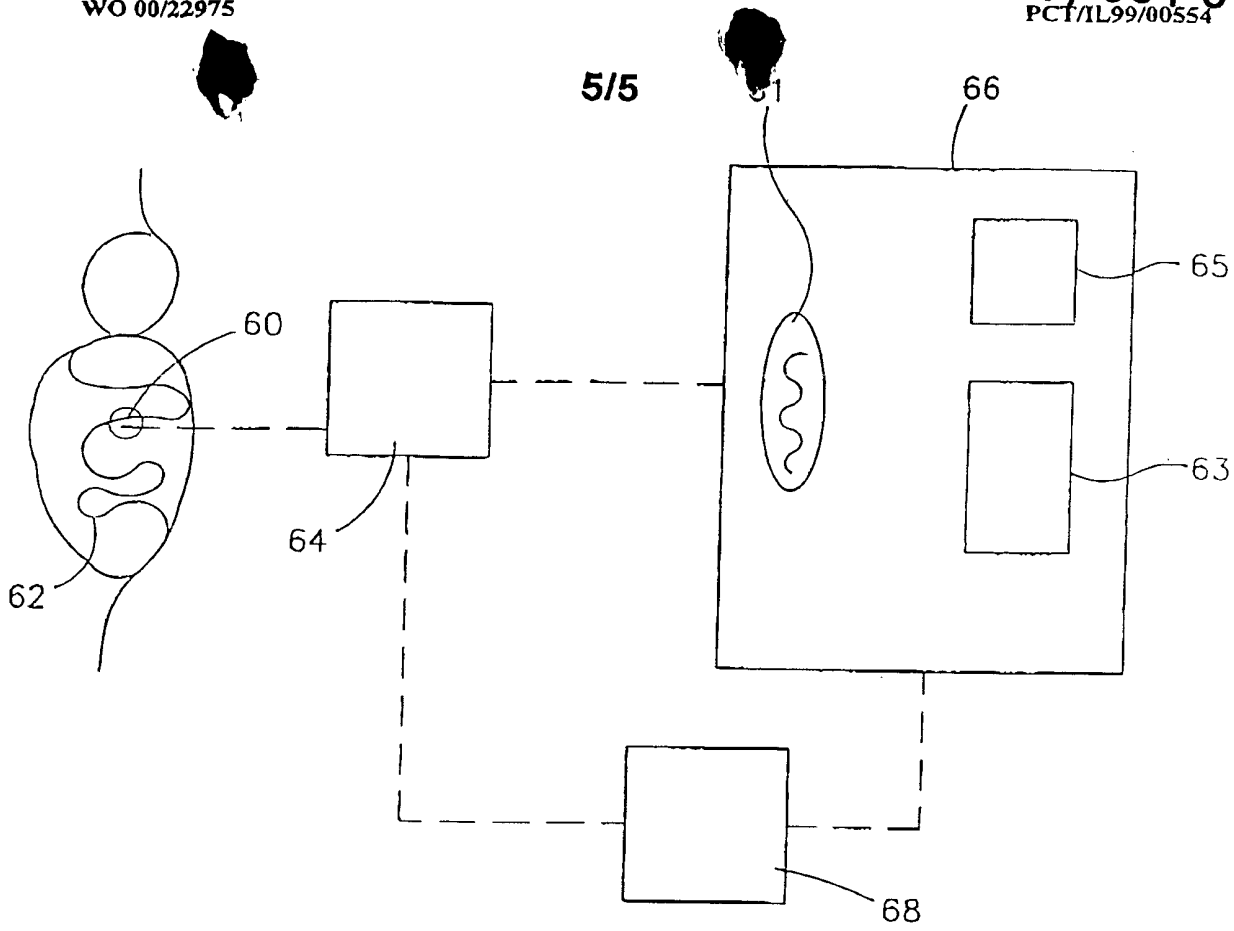

FIG.6

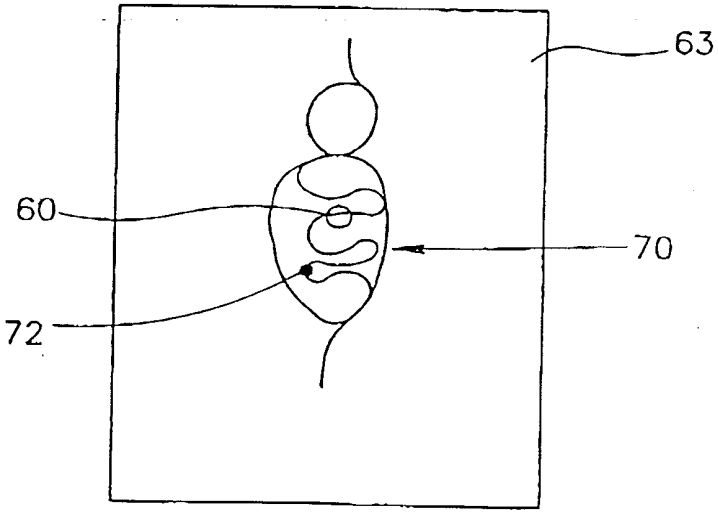

FIG.7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL99/00554

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A61B 1/04
US CL :600/407
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 348/76; 455/66, 95, 100; 600/109, 112 , 407

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,604,531 A (IDDAN et al.) 18 February 1997, entire document.	1-23
X	US 4,278,077 A (MIZUMOTO) 14 July 1981, entire document.	1-23
Y, P	US 5,993,378 A (LEMELSON) 30 November 1999, entire document.	1-23

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents.

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
27 FEBRUARY 2000

Date of mailing of the international search report
04 APR 2000

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer
ELENI MANTIS MERCADER
Telephone No. (703) 308-0899

Form PCT/ISA/210 (second sheet)(July 1992) ★

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To: ZEEV PERL
EITAN, PEARL, LATZER & COHEN-ZEDEK
7 SHENKAR STREET
2 GAV YAM CENTER
HERZLIA 46725
ISRAEL

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of Mailing *(day/month/year)*	14 MAY 2003
Applicant's or agent's file reference: P-1800-PC	IMPORTANT NOTIFICATION

International application No.	International filing date *(day/month/year)*	Priority Date *(day/month/year)*
PCT/IL99/00554	21 OCTOBER 1999	22 OCTOBER 1998

Applicant
GIVEN IMAGING LTD.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

09807892

Name and mailing address of the IPEA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	MARVIN LATEEF
Facsimile No. (703) 305-3230	Telephone No. (703) 308-0899

Form PCT/IPEA/416 (July 1992)★

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P-1800-PC	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/IL99/00554	International filing date *(day/month/year)* 21 OCTOBER 1999	Priority date *(day/month/year)* 22 OCTOBER 1998
International Patent Classification (IPC) or national classification and IPC IPC(7): A61B 1/04 and US Cl.: 600/407		
Applicant GIVEN IMAGING LTD.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17 MAY 2000	08 MAY 2003
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MARVIN LATEEF Telephone No. (703) 308-0899

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/IL99/00554

I. Basis of the report

1. With regard to the elements of the international application:*

[X] the international application as originally filed

[X] the description:
pages 1-13 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the claims:
pages 14-19 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the drawings:
pages 1-5 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

[X] the sequence listing part of the description:
pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

[ ] contained in the international application in printed form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the writen sequence listing has been furnished.

4. [X] The amendments have resulted in the cancellation of:

[X] the description, pages NONE

[X] the claims, Nos. NONE

[X] the drawings, sheets/~~fig~~ NONE

5. [ ] This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

***Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/IL99/00554

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)	Claims	1-23	YES
	Claims	NONE	NO
Inventive Step (IS)	Claims	NONE	YES
	Claims	1-23	NO
Industrial Applicability (IA)	Claims	1-23	YES
	Claims	NONE	NO

2. citations and explanations (Rule 70.7)

Claims 1-15 lack an inventive step under PCT Article 33(3) as being obvious over Iddan et al.'531. Iddan et al.'531 teaches all the features of the instant invention, including the generating of a map as depicted in Figure 6 by element 16, which indicates the position element 16 which displays the past and current location of the capsule and therefore a precise map of the intestines along with the location of the capsule(col. 5, lines 7-16).

Even though Iddan et al.'531 do not teach the use of the device at a plurality of passes, such a method step would have been an obvious modification to one skilled in the art at the time that the invention was made in order to provide for a more accurate depiction of the intestines.

Claims 16-23 lack an inventive step under PCT Article 33(3) as being obvious over Iddan et al.'531 in view of Honda et al.'197. Iddan et al.'531 teach all the features of the instant invention except for the use of spring made out of a memory shape metal. In the same field of endeavor Honda et al.'531 the use of spring made out of a memory shape metal in a capsule to facilitate spread of a liquid medicine or to sample data such as body liquid in the body cavity (see entire document). It would have been obvious to one skilled in the art at the time that the invention was made to have used the memory shape metal as taught by Honda et al.'197 in the device of Iddan et al.'531 in order to allow for the re-use of the capsule (this motivation for combining the references can be found at col. 1, lines 24-27 of Honda et al.'197).

F

US 4,439,197 A (HONDA et al) 27 MARCH 1984, see entire document.